The Nervous System

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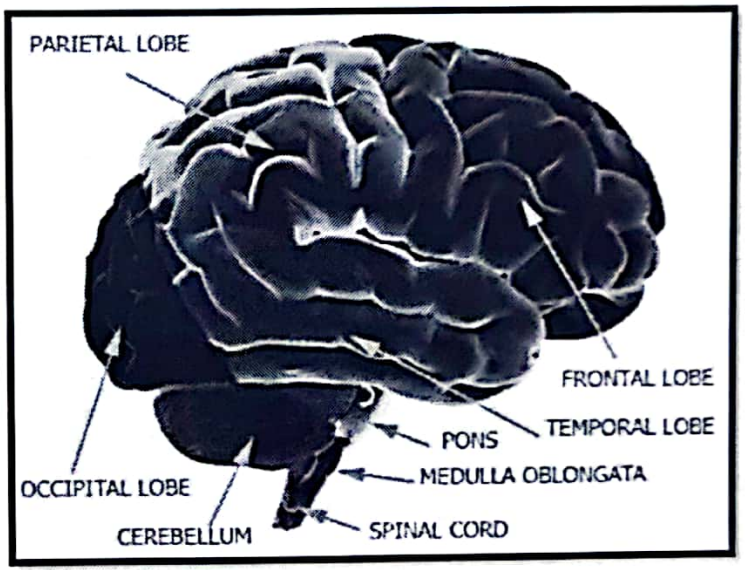
(2021)



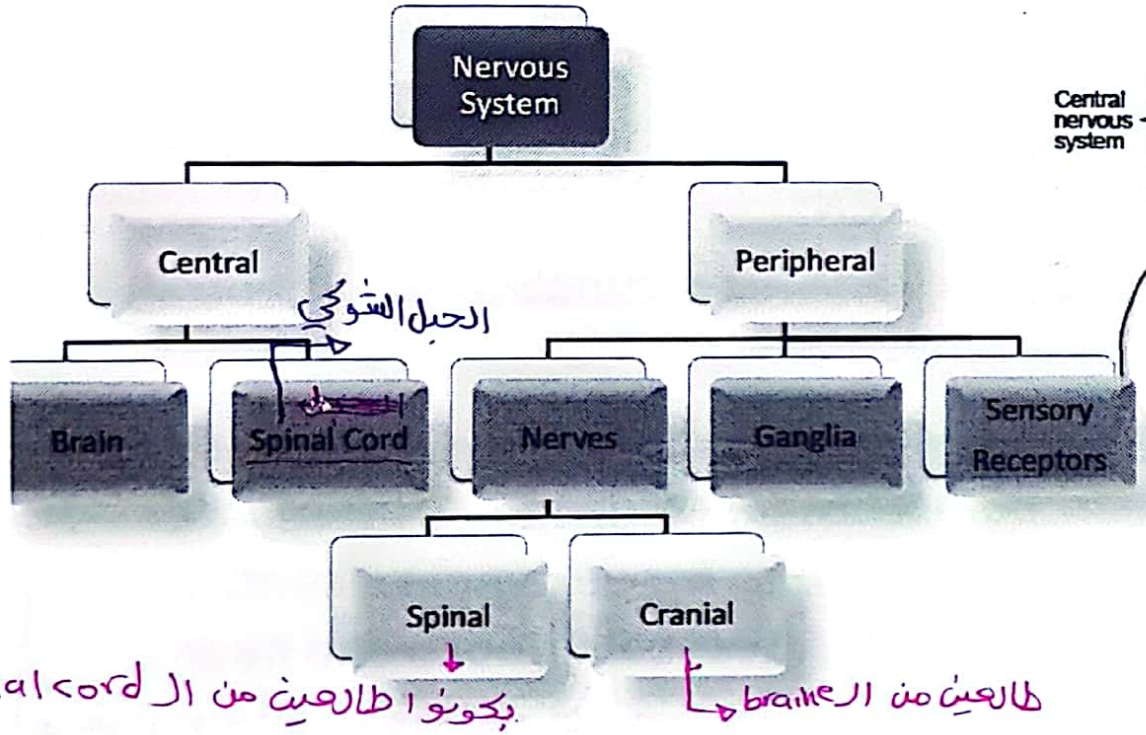
Overview

controlling centre in the body.

The main function

- *The nervous system is the system that **controls** the various functions of the body by the means of **electrical impulses**.*

ال massage اللي بطلعها هاد ال system على شكل electrical impulse (سيالات عصبية)



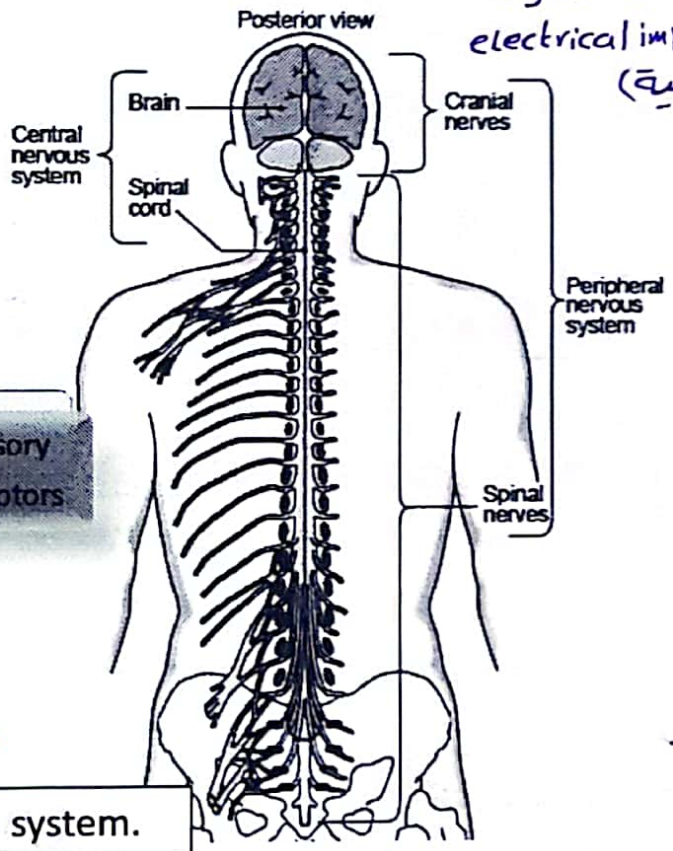


Fig.1: Divisions of the nervous system.

brain

spinal cord

The Central Nervous System (CNS)

- Formed of the brain and spinal cord
- Formed of millions of nerve cells (neurons) and supporting cells (glia cells).
- Well protected within the skull and vertebral column.

spinal cord ← يكون محمي بـ Vertebral column.

brain يكون محمي بـ skull ↓

- **Functions:**

1. **Initiates motor commands (movement and secretions).** → الأوامر بتبدأ من عنده — اوامر
2. **Receives and perceives sensory information.** → sensory part — استقبال المعلومات من الـ
3. **Responsible for our emotions, personality, behavior, memory and others.** — التعابير — شخصيات — ذاكرة

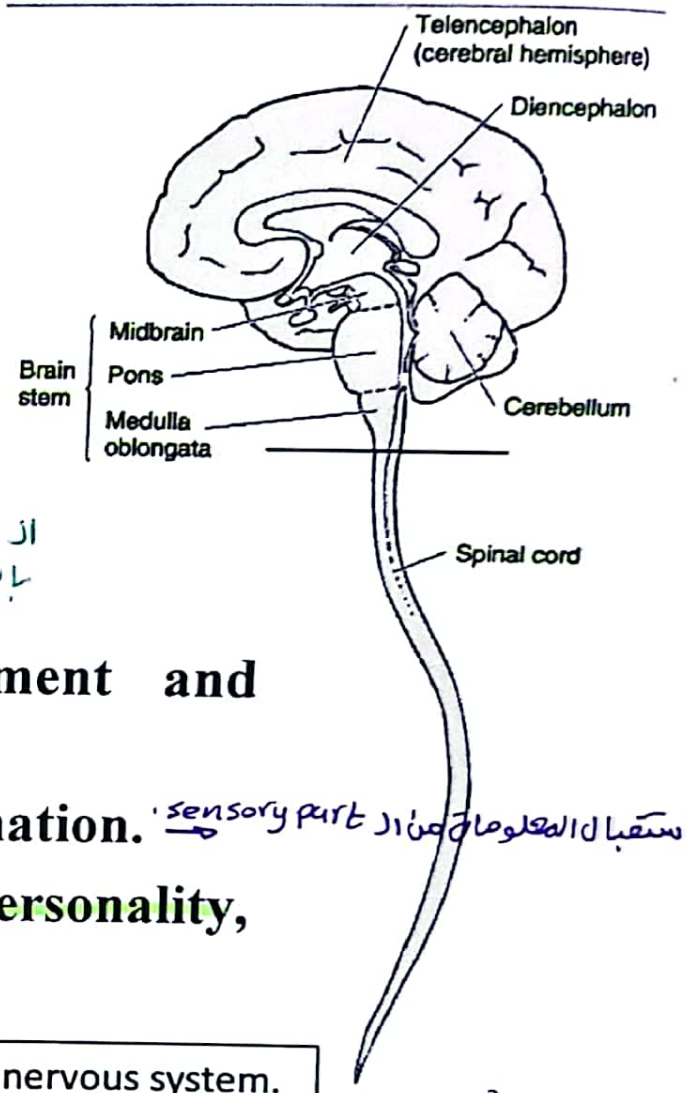


Fig.2: The central nervous system.

The Peripheral Nervous System (PNS)

Nerve
ganglia
sensory receptor

هاد التقسيم بناءًا على ال structure.

- Formed of the peripheral nerves (cranial and spinal), the ganglia, and the sensory receptors.

- The nerves may be sensory (carry information to CNS) or motor (carry orders from the CNS)

from body to CNS
CNS to body
(command)
CNS = central Nervous system.

- **Ganglia** are collection of neurons outside the central nervous system.

تجمع من neurons ال
تجمع

- **Sensory receptors** are parts of neurons or specialized structures that can detect changes in the internal or external environment. The skin, for example, contains several types of receptors that detect pain, touch and heat.

تتحسس

تتحسس اي تغير سواء من ال internal environment او ال external environment

مثال على ال sensory هو ال skin بكون موجود فيها receptor و2 تتحسس لل pain (الم) او تغير درجة الحرارة او اللمس.

peripheral Nervous system

- Functionally, the PNS can be divided into:

يعني الها علاقة بالجسم

- **Somatic part**: connected to skin, muscles, joints and the special senses. We are fully conscious of this part. Our voluntary movements and our sensation of pain and touch are controlled by this part.

واعي — ارادي

عالباً بتكون عند الشخص الواعي والارادي علاقة بالحركات الارادية والإحساس بالألم أو اللمس في هذه الاجزاء

- **Autonomic Nervous System**: this part usually operates without conscious control, as it controls all of our involuntary actions, like our heart rate, respiratory rate and blood pressure.

غير واعي

عادي يكون الشخص غير واعي عليها هي لا ارادي

مثل ال heart rate , respiratory rate , blood pressure هاي الشغلات ما بنقدر نتحكم فيها.

- **Enteric part**: controls the secretions and movements of the various parts of the digestive system unconsciously.

هو جزء مفصول لكن يعتبر جزء من ال Autonomic.

الها علاقة بال digestive system فبكون الها علاقة بال secretion وال movement.

Histology Of The Nervous System

- The nervous tissue is formed of two types of cells:
  1. The nerve cell – Neurons
  2. Supporting cells – Neuroglia or Glia cells

يتكون الجهاز العصبي من نوعين من الخلايا

Extracellular matrix هو اقل نوع من الـ tissue ناحية

- In the nervous tissue, there is ***a very small amount of extracellular matrix*** found around the blood vessels.
- The space between the cells is filled with **neuropil** which is formed of the processes of both neurons and glia cells and some fluid.

هو الجزء المحيط بالخلايا العصبية.

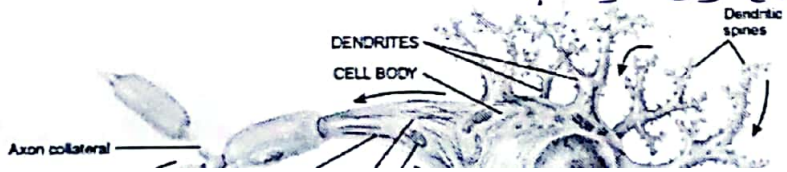
Atom → cell → tissue

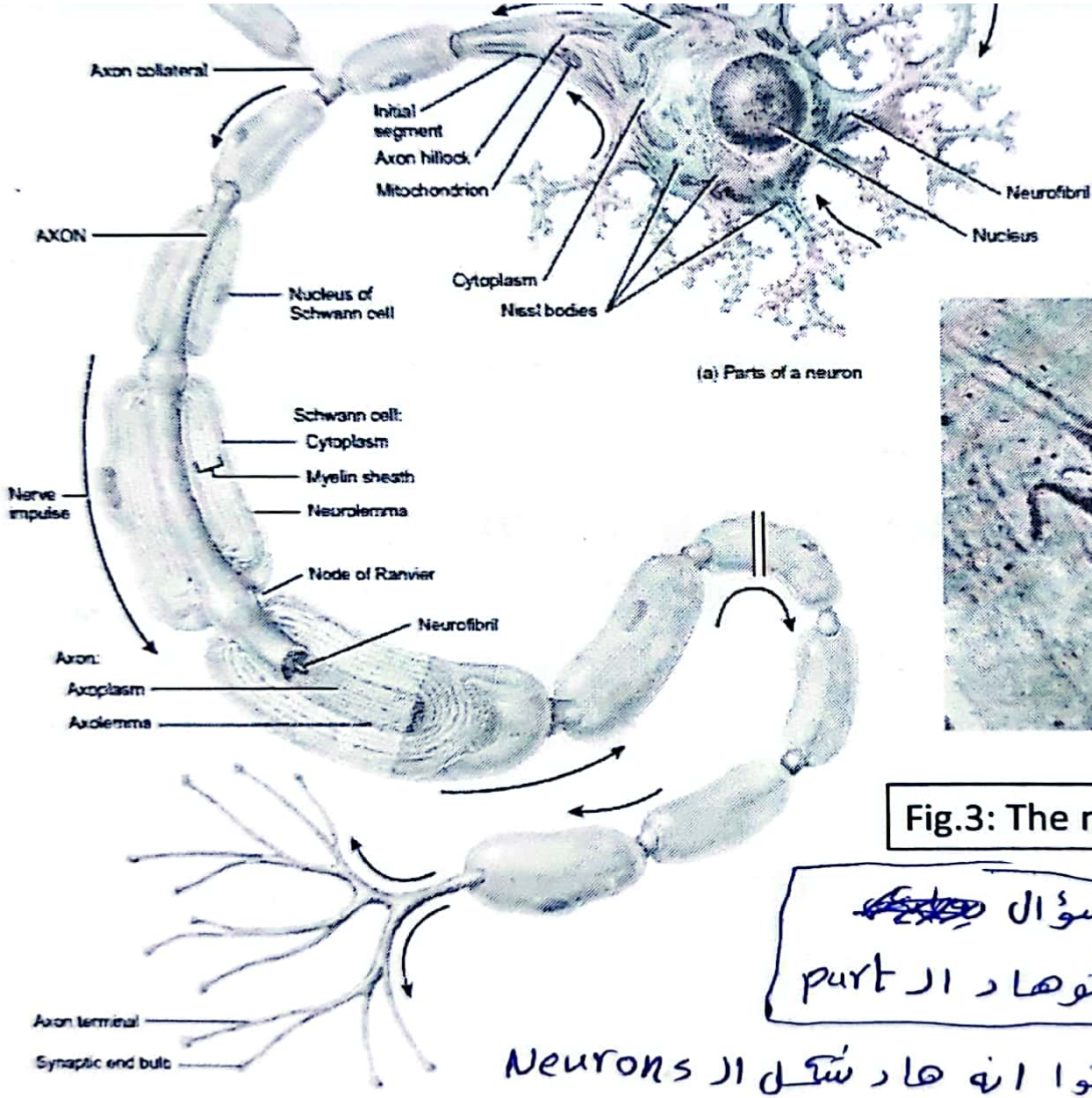
Neurons →

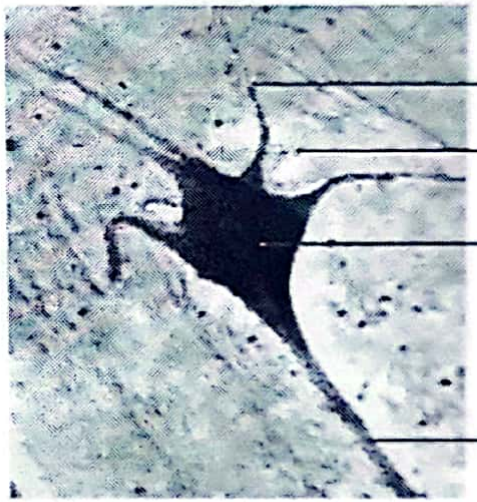
هاد cell المكوّنة لل nervous tissue.

- Functional unit of nervous system.
- Have capacity to produce action potentials. → هي اللي بتبلش السيال العصبي (السيال العصبي بلتقل من خلال الـ neurons لحد ما يوصل الى receptor.
- ① **Cell body:**
  - Single nucleus with prominent nucleolus → نواة مع نوية بارزة
  - *Nissl bodies* formed of rough endoplasmic reticulum & free ribosomes for protein synthesis. → انتاج البروتينات بكثرة
  - Neurofilaments give cell shape and support → مسؤولة عن شكل الخلية وحجم الخلية.
- ② **Cell processes** = dendrites & axons → رح نحكي عن الفرق بينهم بالسلايد اللي بعد.
- **Mature neurons cannot divide. A damaged neuron cannot be repaired and is replaced by fibrous tissue.**

بتتذكروا لما حكينا عن الـ epithelium انه من ميزاتها انه فيها كتير turnover والسبب انها معرضة لل cavities او لل for the outside سواء lining فبالتالي هي معرضة لـ internal and external environment كتير فبالتالي بكون في تجديد للخلايا كتير ولكن هاد الشي موجود بالـ nervous system فال neurons & بنقسم functions ما بتصلح ولكن بستبدل بـ fibrous tissue ولها بستبدل بروح فاذا صارله damage neurons تبعه وبطل الـ شغال.







cell processe

cell processe

Fig.3: The neuron and its parts.

لما مارح يجي سؤال
انه حددوا شوهاد الـ part

بس لازم تفرقوا انه هاد شكل الـ Neurons
والـ main features الله .

cell body تفرعات حول ال

هو تفرع واحد من ال cell body

	Dendrites	Axon
1	Mostly multiple branches	A Single branch
2	Usually short	Usually the longest branch and is called ***nerve fiber***
3	Taper as they extend away from cell body	Has a fixed diameter
4	Branch profusely	▪ No branches near cell body ▪ Collateral branches along course ▪ Terminal branches
5	Not covered by a myelin sheath	Some are covered by a myelin sheath
6	Conduct impulse towards cell body	Conducts impulse away from cell body

dendrites ال ← تضيق
كل ما نوصل لنهايتها بصيرلها تضيق.

Axon ال ← diameter ثابت
تبقى من اول لآخر

تفرعات كثير

عير محاطة بغلاف

محاطة بغلاف

مستقبل ل nerve impulse

يحمل ك carier ل electrical impulse

Glia cells

Location	Cell	Function
CNS	supporting cell ↑ Astrocytes ← لتبكون موجودة بـ blood brain barrier.	• Part of blood-brain barrier • Provide nutrients for neurons • Form scar tissue after injury
	Oligodendrocytes	Form myelin sheath
	Microglia cells	Defense (by phagocytosis)
	Ependymal cells	Line cavities
PNS	Schwann cells (Neurolemmocytes)	Form myelin sheath
	Satellite cells	Support neurons in dorsal root ganglia

تغليف ال axon

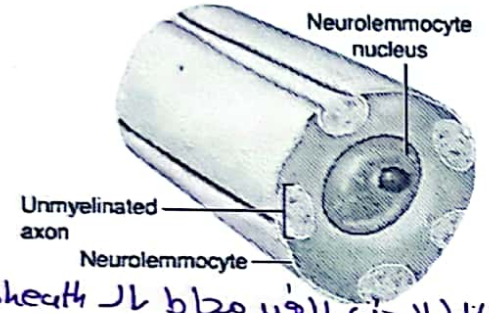
Myelination

- The process by which a nerve fiber (axon) is surrounded by multiple layer of cell membrane (myelin sheath)

وظيفتها تسريع انتقال ال electrical impulses والسبب انه ال electrical impulses بتنتقل على شكل قفزات بالتالي هو ما يعمل من خلال الـ myelin sheath ولكن تقفز على طول الـ myelin sheath

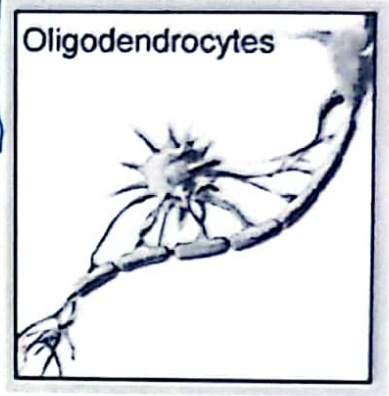
PNS	CNS
Done by Schwann cells	Done by oligodendrocyte
The entire cell wraps around the axon	The process of the cell wraps around the axon
Unmyelinated axons are also surrounded by cell membrane of Schwann cell	Unmyelinated fibers are not surrounded by anything

schwann cell كل الخلية الي بتغلف الـ axon



الـ unmyelinated axon (الجزء الغير محاط بالـ mylen sheath) يكون محاط بالـ cell membrane تبع الـ schwann cell

فقط الـ processe تبعت الـ axon هي الي بتغلف الـ oligodendrocyte



بالـ central الي ما بيكون محاط بـ myelin sheath حتى ما يكون فيه processe ولا حتى cell membrane

Histology of a nerve

Nerve fiber يتكوّن → bundles يتكوّن → Nerve

- **Nerve**: a group of bundles of nerve fibers and their covering connective tissue layers.

- The whole nerve is surrounded by the **epineurium.**
  غلاف يحيط كل (Nerve) bundles الـ
- Each bundle is surrounded by the **perineurium,** which forms a blood-nerve barrier.
  كل bundle لحالها تكون محاطة بغلاف Perinerium.
- Each nerve fiber (axon) is surrounded by myelin sheath and an areolar connective tissue **endoneurium.**
  nerve fiber كل تكون محاطة بطبقة من connective tissue الـ تسمى endoneurium وهي نوع الـ Loose areolar connective.

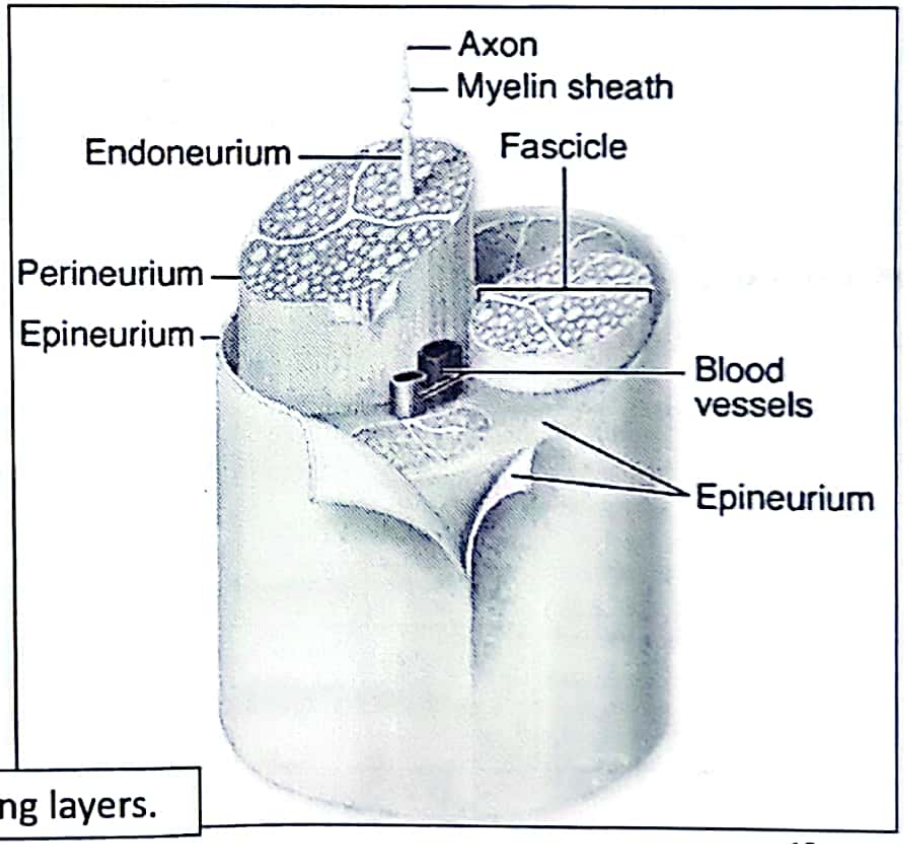


Fig.4: Peripheral nerve and its covering layers.

The Central Nervous System - The Brain

- The brain is the part of the nervous system present within the skull. It's covered by protective layers called the meninges. (غشاء السحايا)

- The brain (الدماغ) is formed of:

1) The Cerebrum → (The largest part of the brain.)
2) The Diencephalon → (مخ)
3) The Cerebellum → (مخيخ)
4) The Brainstem (جذع الدماغ)

تتكون من

- Medulla oblongata (النخاع المستطيل)
- pons
  - it's inferior to the midbrain and superior to the madulla.
- Mid brain

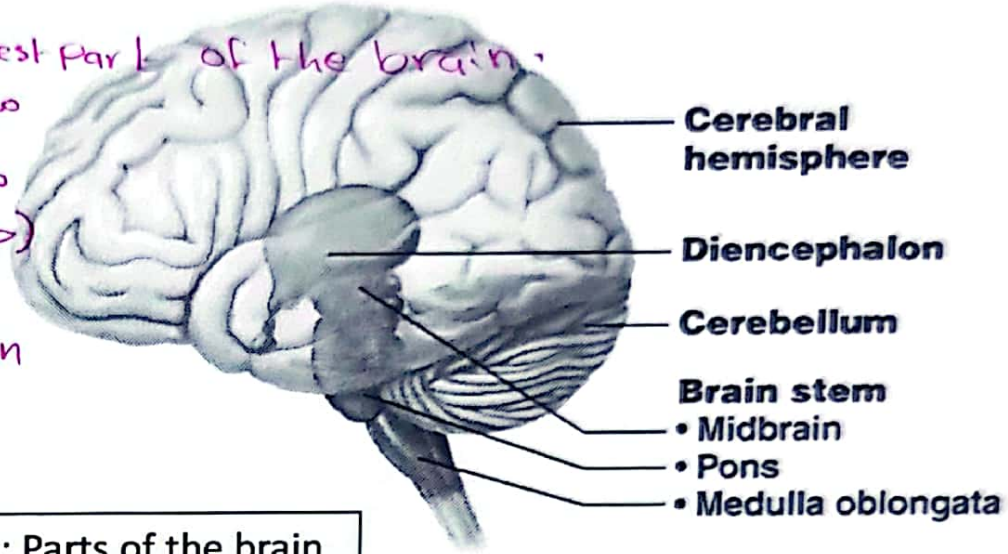


Fig.5: Parts of the brain.

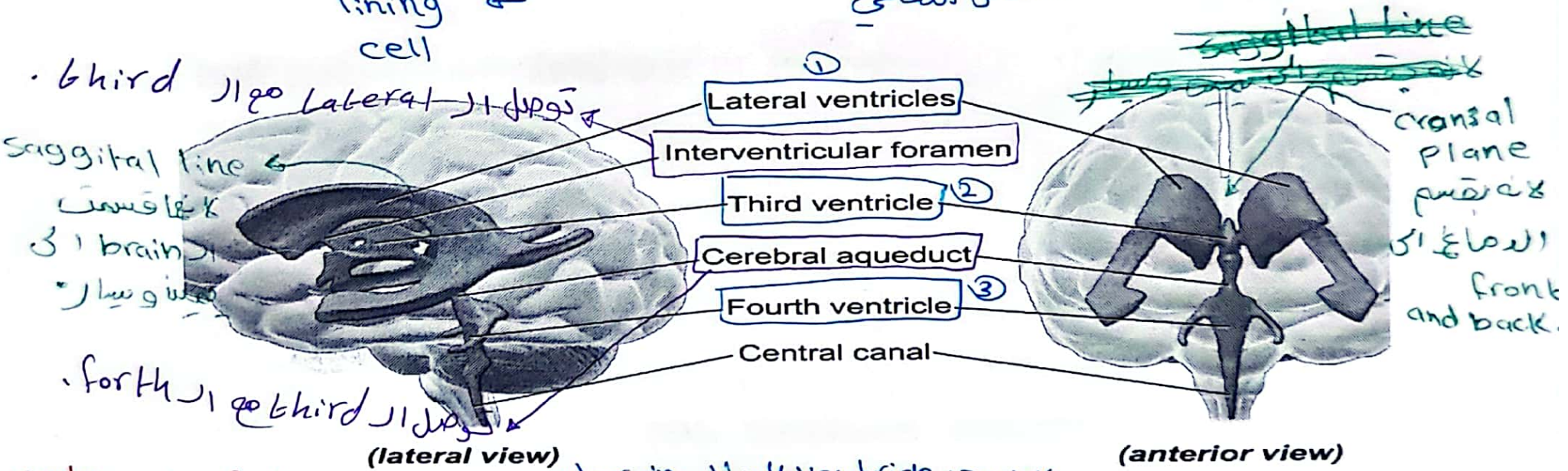
Ventricular system → تجاويف هي عبارة عن cavities مجوفة في الـ brain.

اي من اسم بطين ومعناها تجويف.

Within the different parts of the brain, there are several cavities lined by ependymal cells and filled with cerebrospinal fluid.

lining cell

السائل النخاعي



third الـ مع Lateral الـ توصل

forth الـ مع third الـ توصل

يقسم الدماغ الى front and back.

يقسم الدماغ الى يمين ويسار

* يوجد في الـ brain: 4 ventricle

* ليش (شو الفائدة) من انه تتواصل بين الـ ventricles ؟ لانه الـ ventricle تحتوي على cerebrospinal fluid ووظيفة من الـ function لهاد الـ fluid هي نقل الـ nutrient والـ waste فعشان هيك بتتواصل بينهم.

Fig.6: Ventricles of the brain.

(تسهيل نقل الـ nutrients والـ waste).

* اول اشي بتكون ال skin وبعدها ال skull (الجمجمة) تحت الجمجمة بيجي الدماغ brain
وال brain فيه طبقة ال meninges عباي ال meninge تتكون من 3 طبقات لو بدنا نرتبهم من فوق لتحت فأول طبقة Dura بعدها Arachnoid بعدها pia.

طبقة السحايا المحيطة بالدماغ

Cranial meninges

1. **Dura mater**: the hard outermost layer. Separated from the skull bones by the epidural space. The venous sinuses of the brain are located within the dura mater.

اقرب طبقة للدماغ او لل skull.

حيوب

dura المسافة بين ال skull وال dura تسمى epidural space.

venous sinuses ال تتكون في طبقة ال dura فقط.

2. **Arachnoid mater**: the thin middle layer. Separated from the dura by the subdural space. Beneath the arachnoid, we have the large subarachnoid space.

Dura وال Arachnoid بين ال space ال تسمى subdural space.

ال space بين ال Arachnoid وال pia يسمى subarachnoid وهو اكبر من ال subdural.

cover بتغطي brain لل

3. **Pia mater**: thin innermost layer. Directly covers the brain.

Fig.7: The cranial meninges.

* ترتيب الطبقات من فوق لتحت ← اول طبقة من فوق ال skin وتحتها ال skull و تحتها epidural space وبعدها ال dura mater وبعدها ال subdural space وبعدها ال Arachnoid mater وتحتها ال subarachnoid space وتحتها ال pia mater و تحتها ال brain.

The Cerebrospinal Fluid (CSF)

The Cerebrospinal Fluid (CSF)

السائل الموجود بـ CNS .

- Clear fluid.
- Circulates through cavities (1) in the brain (ventricles) and the spinal (2) cord (central canal) and also in the subarachnoid (3) space.
- ***Functions:***

1. ***Absorbs shock and protects the brain and the spinal cord.*** → تتلقى الصدمات عشان تحمي الـ brain . (والصدمات الضربات)
2. ***Helps transport nutrients and wastes between the blood and the nervous tissue.*** → نقل الغذاء والفضلات بين الدم والأنسجة العصبية.

(BBB) اختصاره

The Blood-Brain Barrier → well functionalize structure in the brain.

structure هي عبارة عن مجموعة من ال
ولكن طبعا كثير limitation عشان تسمح مرور بعض المواد من خلالها الى داخل ال nervous sys.

- This include a number of structures that control the passage of substances from blood to the nervous tissue to protect it against harmful agents.

* ال brain يمنع دخول اشياء عليه الا اشياء محدودة والسبب انه ال structure تبعها كثير well organize.

- It's formed of: مسؤولين عن تبادل ال waste وال nutrient.

1) Endothelium of capillaries
2) Pericytes: cells present around the capillaries beneath its basal lamina
3) Basal lamina → تحيط ال pericyte
4) Processes of astrocytes

تحيط بال endothelium of capillaries

كل العوامل اللي فوق تساعد على انه ما يدخل كل اللي على ال CNS.

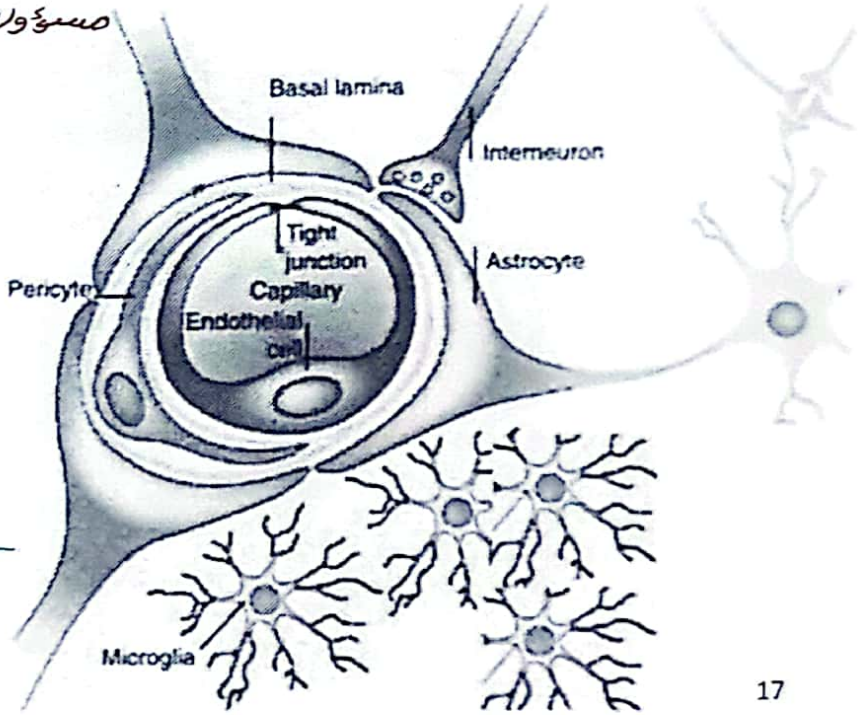


Fig.8: The blood-brain barrier.

اكبر جزء من ال brain.

The Cerebrum

تتكلم بكون فيها تعرجات كتير

مسؤول عن ال motor command

- All motor commands issue from the cerebrum. All sensations are perceived here. In addition, this part is responsible for emotions, behavior and memory.

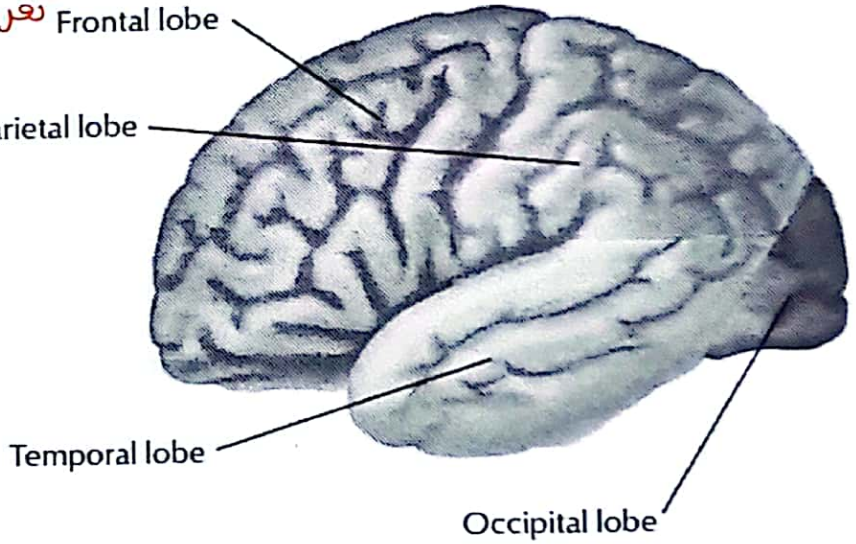


Fig.9: The Cerebrum (lateral view).

- The cerebrum is the largest part of the brain. It's formed of two parts (called hemispheres) each of which is formed of four lobes: frontal lobe, parietal lobe, temporal lobe, and occipital lobe.

بالأمام frontal — على جنب parietal — تحت temporal — تحت occipital

- It's characterized by the presence of fissures called sulci and protrusions called gyri (Fig.11). The cavity within it is the lateral ventricle.

شقوق — نتوءات

الـ fissures تسمى sulci وال protrusion تسمى gyri.